Mobile heat exchanger and system for providing a skating rink provided with such a heat exchanger

The invention relates to a mobile heat exchanger, comprising: at least one assembly of at least two generally rigid pipes for transport of a first medium, and a coupling element which interconnects the two pipes, and feed means and discharge means connected to the assembly for feeding and discharging of the first medium, respectively, the first medium being adapted for heating or cooling of a second medium surrounding the assembly. The invention also relates to an assembly for use in such a mobile heat exchanger. De invention furthermore relates to a system for providing a skating rink having such a mobile heat exchanger.

The mobile heat exchanger mentioned in the preamble is known in itself, and is used in systems for forming a skating rink. By transporting a coolant through the pipes of the heat exchanger, water surrounding the assembly is frozen while the actual skating surface is formed. De skating rinks can be constructed at diverse locations and under varying conditions but are generally only temporarily installed at one location. The known heat exchanger has as an important disadvantage that upon installation and dismantling, the components making up the heat exchanger have to separately assembled or disengaged, respectively. This makes the construction and dismantling of a system provided with such a known heat exchanger relatively laborious and therefore relatively time-consuming and expensive.

It is an object of the present invention to provide an improved heat exchanger, avoiding the above-mentioned disadvantages.

Hereto a heat exchanger is provided according to the invention of the type mentioned in the pre-amble, characterised in that the coupling element can pivot, the pipes being connected in such a way to the pivoting coupling element that the pipes can be hinged with respect to one another between an active operating position in which the assembly has a relatively extended configuration and a non-operative transport position wherein the assembly has a relatively compact configuration. By executing the assembly in a pivoting manner between an operative position and a transport or storage position the relatively complex actions relating to assembly and dismantling, discussed above, are no longer required. A change in the configuration only of the assembly suffices for changing the transport configuration into the operative configuration, and vice versa. Assembling and

dismantling of the mobile heat exchanger in accordance with the present invention, therefore is relatively simple in view of which the heat exchanger can be assembled and dismantled relatively rapidly and cheaply. After use, the heat exchanger can be transformed into its relatively compact transport position and can be transported as a single compact unit. In the compact transport position, the assembly can be doubled over or folded in a zig-zag manner in case the assembly comprises more than two pipes. It is however as possible to in fact roll up the assembly around a rotating frame, such as a reel.

In a preferred embodiment, the coupling element is at least partly formed by a tubular member. Particularly in case the pipes are tubular as well, use of a tubular body is advantageous. In that case the tubular body is congruent with the pipes such that the coupling element is not, or barely, provided with projecting parts, whereas the throughflow of the first medium through the assembly is not, or at least hardly, restricted. In this manner a relatively smooth assembly is provided which can be transformed easily between an operative position and a transport position.

In another preferred embodiment the joint member is of at least partially elastic, or at any rate flexible, construction. By making the joint member flexible it is relatively easy to transform the extended configuration of the assembly into the compact configuration of the assembly and vice versa. In a particular preferred embodiment, the joint member is made of rubber, in particular ethylene propylene diene monomer (EPDM). EPDM is a synthetic rubber that usually is very suitable for use as a joint member since EPDM is relatively strong, durable and permanently elastic. Moreover, EPDM can be manipulated at relatively low temperatures (down to about -40 °C). In addition, EPDM has a relatively high chemical resistance and a relatively high elongation at break of approximately 400 %.

Preferably, the longitudinal pipes are connected to the joint member some distance apart. Positioning the pipes some distance apart and connecting to the joint member in this way usually makes it easier for the assembly to swing, since there will be no friction between the successive longitudinal pipes during swinging of the assembly. In a particular preferred embodiment, an external diameter of each pipe is smaller than half of the spacing between the pipes. By allowing the spacing between the pipes to be at least twice the external diameter, the extent to which the assembly can be swung will be made even more flexible. Moreover, in this way it will be possible in a relatively simple manner to fold up the assembly completely into the relatively compact transport position.

Preferably, the joint member is provided with at least one mechanical joint. The

mechanical joint can be of very diverse types. Preferably, the joint member is also provided with locking means for locking the joint in the use position and/or in the transport position. The joint member is also preferably provided with a valve closure or other similar closure so that when the pipes are swung with respect to one another the first medium is retained in the pipes concerned. In this way loss of the first medium contained in the pipes can be prevented or at least counteracted.

In a preferred embodiment the assembly is provided with a number n of pipes and a number (n-1) of joint members for connecting the n pipes to one another, where n is greater than two. The assembly is thus not restricted to two pipes but can be provided with several pipes, as a result of which the assembly can acquire a relatively long length.

In another preferred embodiment, the heat exchanger comprises a number of interconnected assemblies which are oriented at least generally in a parallel orientation with respect to one another. In this manner a relatively wide unit of assemblies can be achieved whereby relatively large heat exchanging surfaces can be provided. In a particular embodiment, the assemblies are held a distance apart by at least one spacer. In this way an ordered unit of the assemblies is obtained with which the surface area/volume ratio has at least essentially already been determined in advance. In one embodiment, the spacer and the joint member are joined to one another and in particular are integrated with one another.

Preferably, the pipes are made of metal, in particular aluminium. Metal, in particular aluminium, has the property of conducting heat particularly well. Thus, by using pipes made of aluminium in combination with joint members that have the same thermal conductivity, such as aluminium joint members, uniform heat exchange can take place between the first medium and the second medium. Moreover, pipes made of metal are relatively durable, strong and inexpensive. In addition to the abovementioned advantages, aluminium also has the advantage that this material has a relatively low density, as a result of which the relatively lightweight assembly can be transformed relatively easily from the use position into the transport position and vice versa.

In another preferred embodiment, the pipes are connected in a medium-tight manner by the coupling element both in the operative configuration and the transport configuration. As was described above, such a medium tight connection can be achieved by use of a flexible, in particular elastic coupling element.

The invention furthermore relates to an assembly for use in such a mobile heat

exchanger.

The invention relates as well to a system for a system for creating an ice rink comprising such a mobile heat exchanger and a cooling unit connected to the assembly for cooling the first medium. The cooling unit can be of very diverse types, but preferably must make efficient use of space, be relatively quiet and have a low energy consumption. Preferably the system comprises a housing for water that at least partly surrounds the system. The housing will generally be constructed from a substructure below the assembly and upstanding walls connected to the substructure, the housing being impermeable for water irrespective of its temperature.

In a preferred embodiment the first medium is glycol. Glycol is usually very suitable as a coolant and is cooled by the cooling unit to a temperature of between approximately -12 °C to approximately -25 °C before the (liquid) glycol is fed through the assembly.

In another preferred embodiment, the discharge means are coupled to the feed means for recirculation of the first medium. In this way a fully closed system is provided which is generally advantageous.

The invention will be explained with reference to non-limiting illustrative embodiments shown in the following figures. In the figures:

Fig. 1 shows a side view of part of a heat exchanger according to the invention in an extended use position,

Fig. 2 shows a side view of the heat exchanger according to Fig. 1 in a compact transport position,

Fig. 3 shows a side view of the heat exchanger according to Fig. 1 in another compact transport position,

Fig. 4 shows a side view of part of an assembly according to the invention,

Fig. 5 shows a side view of part of another assembly according to the invention, and

Fig. 6 shows a perspective view of a system for creating an ice rink in accordance with the invention;

Fig. 1 shows a side view of part of heat exchanger 1 according to the invention in an extended use position. The part shown comprises several assemblies 2 of pipes 3 for a first medium that are connected together parallel to one another in the extension of one another by means of separate flexible hoses 4. Now only a single assembly 2 is shown. The assemblies 2 are coupled to one another by means of a collector 5 at one end and several transverse connectors 6 at the other end. The assemblies 2 are held a constant distance apart

by means of several spacers 7 fitted around the assemblies 2. The heat exchanger 1, or at least part thereof, is now shown in a position ready for use, in which the first medium can be fed through the assemblies 2 and with which the surface area/volume ratio of the assemblies 2 is maximised.

Fig. 2 shows a side view of the heat exchanger 1 according to Fig. 1 in a compact transport position. After the heat exchanger 1 has been used it no longer has to be (completely) disassembled, in contrast to the heat exchangers known from the state of the art. The flexible hoses 4 connecting pipes 3 now act as an element that allows swinging, as a result of which disassembly of the pipes 3 is no longer necessary because the extended position according to Fig. 1 can be transformed into a relatively compact transport position. The pipes 3 of the assemblies 2 are folded up in a zig-zag manner, as a result of which a compact construction is produced that is ready for storage and/or transport. With this arrangement the assemblies 2 can remain connected to one another by the collector 5 and the transverse connectors 6.

Fig. 3 shows a side view of part of a heat exchanger 1 according to Fig. 1 in another compact transport position. In contrast to the position shown in Fig. 2, the assemblies 2 have now been uncoupled from one another by removing the collector 5, the transverse connectors 6 and the spacers 7. Each assembly 2 is now wound up around a rotary beam 7', which beam 7' is supported by a supporting structure 8. As shown in the present illustrative embodiment, if each assembly 2 were to comprise several pipes 3 it would be conceivable to fit the assembly 2 in a helical manner around the rotary beam 7'. The length of each pipe 3 can now essentially correspond to the length of each of the sides 9 making up the beam 7', so that the flexible hoses 4 enclose three of the ribs 10 making up the beam 7'.

Fig. 4 shows a side view of part of an assembly 11 according to the invention. The assembly 11 comprises two pipes 12 for a fluid, in particular a liquid. The pipes 12 are positioned some distance apart but are connected to one another by a flexible hose 13. The hose 13 is preferably made of rubber, in particular of EPDM. The advantages of this synthetic rubber have already been described in detail above. An interior side of the hose 13 is stretched onto an external side of each of the pipes 12 so that it grips. In order to improve the fixing of the hose 13 to the pipes, (conventional) hose clips 14 can be fitted at either end of the hose 13. An adhesive can optionally additionally be applied between the hose 13 and the pipes 12. It should be clear that the pipes 12 can swing with respect to one another, as a result of which the assembly can be positioned in an extended position ready

for use and a folded-up transport position.

Fig. 5 shows a side view of part of another assembly 15 according to the invention. The assembly 15 now comprises two pipes 16 that are fixed to one another by means of a mechanical joint 17. The joint 17 comprises two joint parts 18 that can swing with respect to one another and locking means 19, joined to the joint parts 18, for locking the hinge 17 in an operational use position. The pipes 16 are connected to the hinge 17 by means of a screw joint 20 (shown in broken lines). The joint 17 can be provided with a valve mechanism, which is not shown, to prevent a fluid present in the pipes 16 leaking out. In addition, each joint part 18 can be provided with a seal surrounding the pipes 16 in order to counteract fluid leaks. It should be clear that the pipes 16 can swing with respect to one another and thus can be configured in a use position as shown or in a compact, folded-up transport position.

Fig. 6 shows a perspective view of a system 21 for creating an ice rink in accordance with the invention. The system comprises a housing 22 for several assemblies 23 of pipes 24 and coupling elements 25 allowing swinging coupled to one another. Water is contained in the housing 22 (not shown). The assemblies 23 are kept a distance apart by a spacer 26. The construction and mode of operation of the assemblies 23 has already been discussed in more detail above. The pipes 24 preferably have a length of approximately 5 metres and an external diameter of approximately 19 millimetres. The distance between the pipes 24 is approximately 5 centimetres. At one end the assemblies 23 are coupled to one another by several transverse connectors 27 and at the other end are connected to two collectors 28. Glycol, which has been cooled to approximately -12 °C by a cooling unit 30, can be fed through the assemblies 23 with the aid of a pump 29 connected to one collector 28, as a result of which water contained in the housing 22 and surrounding the assemblies 23 will freeze with the formation of the ice rink. Preferably, the pipes 24 are positioned (some) distance away from the housing 22, so that the water can completely surround the pipes 24 on all sides. The housing 22 has a medium-tight substructure 30 for containing the water and a raised border 31, screening the ice rink, joined to substructure 30. After use of the ice rink, the assemblies 23 can be transformed easily and rapidly into a relatively compact transport position, after which the folded-up unit of assemblies 23 can then be transported. As a result of the use of the system 21 according to the invention, labour-intensive and time-consuming disassembly of separate components of the system is therefore no longer necessary.